

REC'D 27 SEP 2000

The Patent Office

WIPB Concept House FCT

Cardiff Road

Newport

South Wales

NP10 8QQ

**PRIORITY  
DOCUMENT**

SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)

GB 00/02961

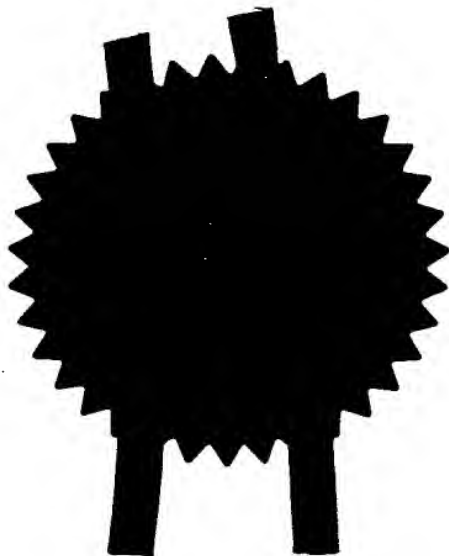
I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

4

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed

*M. C. K.*

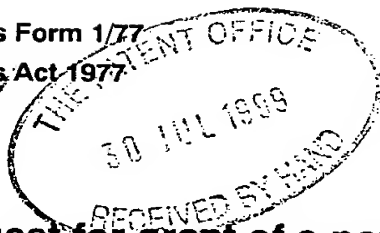
Dated

27 SEP 2000

Patents Form 1/77

Patents Act 1977

(Rule 16)



**The  
Patent  
Office**

02AUG99 E466240-2 D02917  
P01/7700 0.00 - 9917985.5

**Request for grant of a patent**

The Patent Office  
Cardiff Road  
Newport  
Gwent NP9 1RH

1. Your reference  
**1830901/AM**
2. Patent Application Number  
**9917985.5** **30 JUL 1999**
3. Full name, address and postcode of the or of each applicant (*underline all surnames*)  
**Scientific Generics Limited**  
**Harston Mill**  
**Harston**  
**Cambridgeshire CB2 5NH**  
  
Patents ADP number (*if known*) **5693874002**  
  
If the applicant is a corporate body, give the country/state of its incorporation  
Country: **ENGLAND**  
State:
4. Title of the invention  
**ACOUSTIC COMMUNICATION SYSTEM**
5. Name of agent  
**Beresford & Co**  
  
"Address for Service" in the United Kingdom to which all correspondence should be sent  
**2/5 Warwick Court**  
**High Holborn**  
**London WC1R 5DJ**  
  
Patents ADP number **1820001**
6. Priority details  

Country	Priority application number	Date of filing
---------	-----------------------------	----------------

# Acoustic Communication System

This document describes a system for communicating information acoustically by embedding it within an audio signal. It extends the Signalling system described in the patent application GB98/00151, the content of which is incorporated herein by reference.

## Description

The main characteristics of the system are as follows:

- The system consists of an encoder, which combines a digital input stream with an audio signal, and a decoder which separates the embedded information stream from the encoded audio signal, linked by any communications channel, real time or delayed, suitable for transport of audio signals.
- Digital information is embedded within the audio signal in such a way that it becomes part of the signal.
- The use of direct sequence spread spectrum coding allows the data to be spread across all or part of the audio band, or across a number of sub-bands within the audio channel.
- It is optionally shaped to take account of the psycho-acoustic behaviour of the ear in both frequency and time in order to achieve better signal masking.
- It is optionally adjusted according to the characteristics of the communications channel allowing optimal performance.
- Channel shaping and signal pre-emphasis may be performed for the channel bandwidth as a whole, or the channel may be divided into a number of sub-bands, each of which is separately encoded.
- The modified audio signal containing the information may be indistinguishable from the original sound to the untrained listener.
- The resulting audio signal containing the original sound and the embedded information can be transported across any conventional communications channel,

such as that used for broadcast TV or radio distribution, or stored on CD or tape, without the need for any modification to the communications system.

- The communications channel can be electronic (analogue or digital) or acoustic, i.e. the signal propagates through the air or other medium capable of propagating sound waves.
- The signal can be reproduced by a device having a conventional loudspeaker, and received by a device having a conventional microphone.
- The receiving device applies any necessary signal equalisation, and de-spreads the signal to extract the information from the audio signal.
- The information may include forward error correction, interleaving or other conventional systems for managing errors in the communications channel.
- The data may be scrambled, encrypted, or protected in other ways to prevent unauthorised reception and decoding, as required by the application.
- Since the information is embedded into the audio signal utilising as much of the available bandwidth as possible it is almost impossible to remove without seriously affecting the quality of the audio. Once embedded the information becomes an essentially indelible part of the signal.
- By using different spreading codes multiple streams of information can be embedded within an audio signal. The decoder is able to extract one or more of the streams.
- By equipping both ends of the system with encoder and decoder functions, two-way communications can be achieved.
- The system thus provides end-to-end communications between an encoding point and the decoder across any channel suitable for the transport of audio signals without the need for any additional infrastructure.

Figure 1 is a block diagram of the encoder device.

Figure 2 is a block diagram of the decoder device.

Both encoder and decoder may be physical devices, or may be implemented entirely in software which resides on a suitable general purpose computing platform.

## Applications

The Acoustic Communication System described may be used for a number of novel applications:

### Data distribution in broadcast applications

Figure 3 shows a diagram of a generic broadcast application for the Acoustic Communication System.

The content creator combines the digital information stream with the audio channel of the content, using the encoder device, and stores it on a conventional CD, tape or storage medium prior to broadcast. The broadcaster transmits the programme content in the normal manner using the normal distribution channels which may be analogue

or digital including wired and wireless technologies. The broadcaster makes no modifications to the broadcast system, and need not even be aware that the content contains the embedded information.

The user receives the broadcast programme material using a standard TV set or radio receiver. A consumer appliance containing a microphone and decoder device is able to "listen" to the sound and extract the data stream from it. The appliance may be a special purpose information device, or it could be integrated with the TV set, radio, or with other consumer products such as toys, mobile phone, PDA, smart kitchen devices, security systems etc.

In a variant of the system, shown in Figure 4, the information stream may be encoded into the audio channel in real time at the point of play out over the broadcast system.

Examples of particular applications are:

- Toys and games which "listen" to the broadcast programme content, extract the underlying information and use it so that they appear to react to the programme. Such a toy could be a playmate which shares the programme with the child, providing additional interest and supporting learning and education for the child. Authors of education and entertainment programmes for children would produce content which includes embedded information targeting the toy.
- Audit of advertising and content broadcast. Items of content, including music and advertisements, would have embedded within them unique digital information streams. These could be decoded and automatically used to audit broadcast schedules, or viewer behaviour. When used for monitoring user behaviour it is possible to derive information about programmes recorded and watched later, since the information is preserved through the recording process and reproduced on playback.
- Information distribution to intelligent home appliances. The appliance could, for example, automatically decode a cooking recipe from a TV programme about cooking, or the home heating system could extract information about the weather. A compact display device could keep track of the latest score in a sports match, or news headlines as they happen. The system could be used as an alternative distribution channel for teletext information, or for traffic information on the radio in a similar way to RDS.
- The system could provide an alternative distribution channel for paging information, rather than using a bespoke radio network as done conventionally.
- The information could provide updates to programme schedules, delays or changes, and thereby provide a more reliable trigger for the recording device, in a similar way to the existing PDC system for TV.

#### Applications within the home.

A multimedia PC can be used to communicate with another device.

The multimedia PC contains a sound card and has loudspeakers and microphone attached. The user is able to play audio files containing embedded information. Alternatively the user is able to run software performing the encoding and decoding functions, enabling information to be embedded in sound which the PC plays, and to decode information from sounds picked up by the microphone. These functions are made possible in software on the multimedia PC without the addition of any hardware.

In principle the multimedia PC can communicate with any device having a microphone and./or loudspeaker and supporting suitable decode and encode functions.

In a variant of this system a CD or tape which has audio containing an embedded information stream is played using any conventional CD player, tape recorder, or other reproduction device. An appliance containing microphone and decoder is able to extract and act on the embedded information.

Examples of particular applications are:

- Computer controlled toys. Using a standard multimedia PC without any additions apart from an appropriate software application, the user is able to communicate with toys containing suitable decoder and encoder capability. The software could enable the user to control or instruct the toys, or for the toys to respond to the PC.
- Toys that respond to music. A music CD or tape would have embedded within the audio and information stream that the toy decodes and responds to. It may, for example, dance, gesture or speak. The user is able to play the CD or tape on his usual player.
- Communication between the computer and smart devices such as a PDA or mobile phone.
- Control of home devices and appliances from a multimedia PC. This could include, for example, control of environmental control systems or security systems.

In one embodiment, the data is embedded within the broadcast audio by simply adding the encoded data to the audio signal prior to broadcasting. In order for the data not to be heard by the untrained ear, its power level is always maintained a predetermined amount beneath the power level of the audio signal. In particular, the audio signal is analysed to determine how its energy is distributed over the audio frequency range. The data is then combined with the necessary code to ensure that its energy is distributed in a similar manner, but at a predetermined amount beneath the audio signal's energy level.

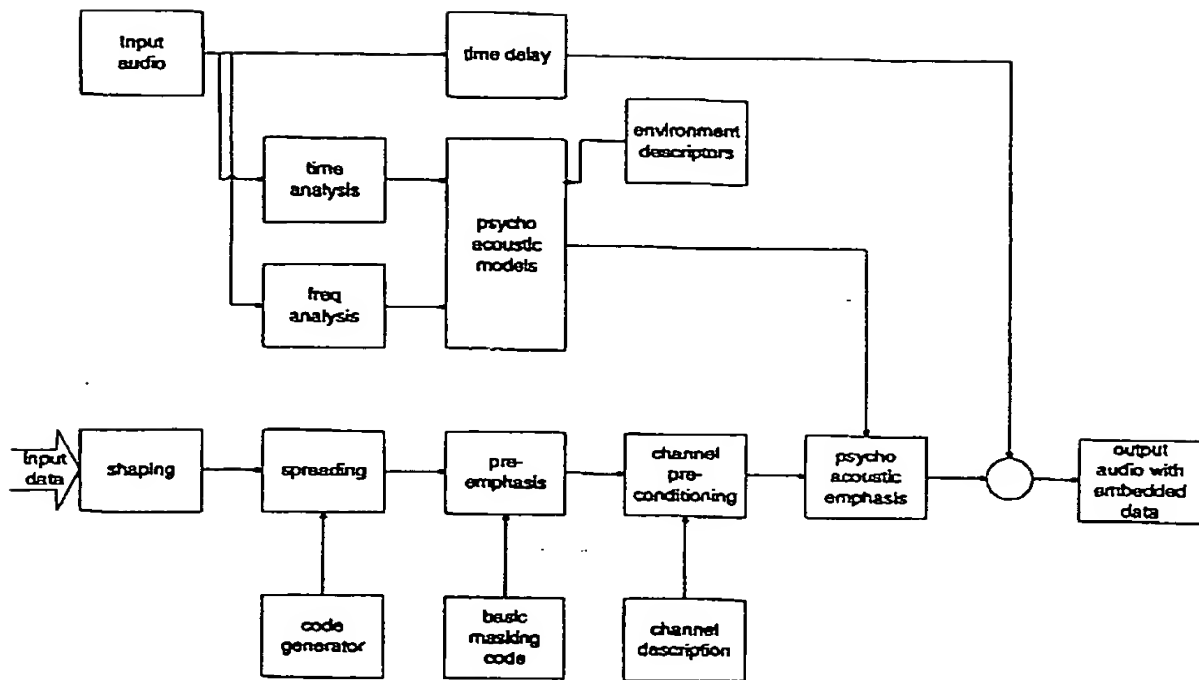


Figure 1 - Encoder block diagram

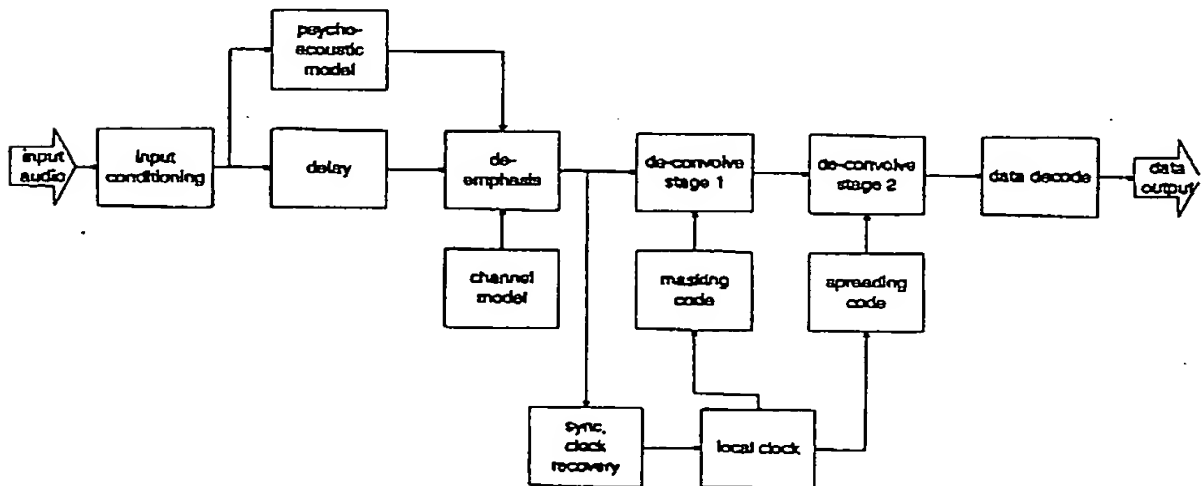


Figure 2 - Decoder block diagram

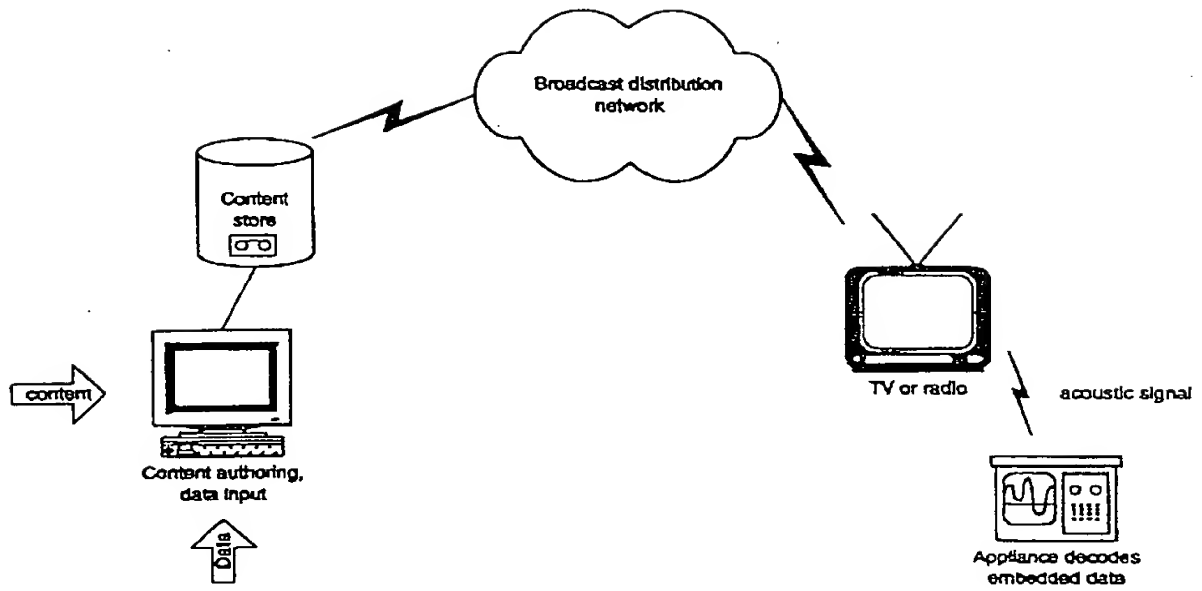


Figure 3 - General broadcast application

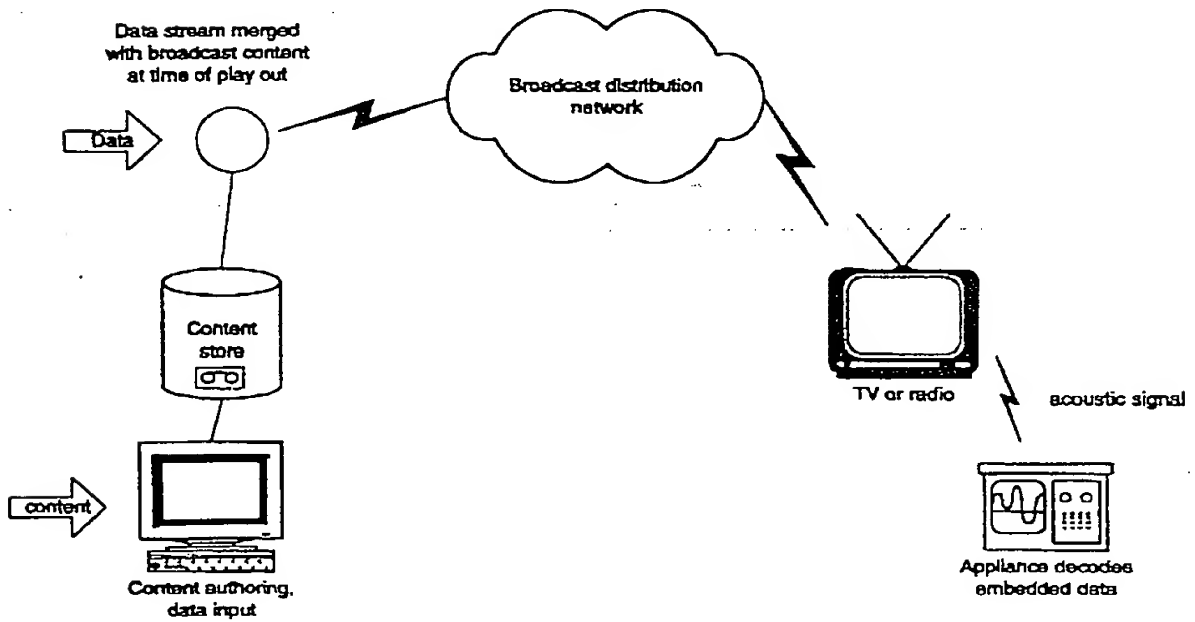


Figure 4 - Broadcast with real time data insertion